

# Foot health-related quality of life among elderly with and without lesser toe deformities: a case–control study

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**Purpose:** The aim of this study was to compare the health-related quality of life impact related to foot health and health in general in older adults with lesser toe deformities (LTD) and without any foot conditions.

**Methods:** A case–control observational study was carried out following the Strengthening the Reporting of Observational Studies in Epidemiology criteria. A total of 100 older adults with a mean age of  $74.39 \pm 6.02$  years were recruited at an outpatient clinic; 50 of these subjects had LTD (case group) and 50 subjects were without any foot conditions (control group). Presence of LTD was determined in both feet using the Kelikian push-up test, and the Foot Health Status Questionnaire scores were self-reported.

**Results:** The case group showed lower scores in quality of life in relation to health in general and to foot health specifically. Statistically significant differences ( $p < 0.05$ ) between case and control groups were shown by means of the Wilcoxon test.

**Conclusion:** A negative impact in quality of life in relation to foot health should be considered in older adults with LTD, regardless of gender.

**Keywords:** aged, foot deformities, foot disease, quality of life, toes

## Introduction

Musculoskeletal foot and ankle problems may comprise up to 8% of the primary care consultations in the UK. Regarding the specified foot and ankle regions, the toe conditions presented a prevalence of 14% among the nontraumatic disorders. Annual consultation prevalence showed a peak from 65 to 74 years old affecting 411 older adults per 10,000 registered persons.<sup>1</sup> Indeed, foot problems may be considered as common conditions in older adults affecting from 71% to 87% of older patients.<sup>2–5</sup> These foot problems may be associated with high cost and economic burden as well as lead to foot and ankle surgery.<sup>6</sup> Incorrect fitting footwear seems to be frequent in older adults and is strongly associated with foot pain and forefoot conditions. Indeed, older adults who wore shoes shorter than the foot were commonly associated with lesser toe deformities (LTD).<sup>7</sup>

LTD may be considered a common condition in older people.<sup>5,8</sup> The prevalence rates varied from 24% to 60% in institutional and clinical settings.<sup>2,9</sup> Furthermore, functional disability, mobility limitations, foot pain, atrophy of the plantar soft tissues under the metatarsal heads, increase risk of falls, and other factors associated with LTD remain unclear in older adults.<sup>3</sup>

Clinical evaluation may allow differentiation of the LTD degree and determine the digital disorder types which may be similar to each other (hammer, claw, and

mallet toes).<sup>5,10</sup> First, a hammer toe is commonly presented in the 2nd toe with metatarsophalangeal dorsiflexion, plantarflexion of the proximal interphalangeal joint, and normal or dorsiflexion position of the distal interphalangeal joint.<sup>11</sup> Second, claw toes appear frequently secondary to neuromuscular conditions and comprise metatarsophalangeal extension contracture as well as proximal and distal interphalangeal flexion contracture.<sup>12</sup> Third, mallet toe deformity seems to be associated with LTD and inadequate footwear as well as is comprised of distal interphalangeal isolated flexion and hammer toe as a proximal interphalangeal primary flexion deformity, with or without metacarpophalangeal hyperextension, with neutral or hyperextended distal interphalangeal joint.<sup>13</sup>

Indeed, LTD is a multifactorial, complex, and poorly understood condition which may be secondary to genetic predisposition,<sup>9</sup> a traumatic event, improper shoe wear,<sup>14</sup> neuromuscular conditions,<sup>15</sup> inflammatory and metabolic alterations,<sup>16</sup> inadequate strength of the toe intrinsic flexor muscles,<sup>12</sup> as well as may be accompanied by the presence of pain,<sup>17</sup> corns,<sup>18</sup> postural disturbances,<sup>19</sup> high forefoot plantar pressures,<sup>20</sup> and footwear difficulties.<sup>21</sup> Nevertheless, the LTD impact on older adults' quality of life related to foot health remains unclear.

Consequently, attention and follow-up in foot care for older adults who suffer from this chronic disease should be considered.<sup>22</sup> Illnesses and deformities of the foot, postural alterations, and other basic conditions should be included in the treatment and preventive care activities in order to get a better quality of life and well-being for older people.

Therefore, the aim of this study was to compare the health-related quality of life impact related to the foot health and health in general in older adults with LTD and in older adults without any foot conditions.

## Materials and methods

### Design and sample

A case-control observational study was carried out following the Strengthening the Reporting of Observational Studies in Epidemiology guidelines. A total of 129 older adults with similar socioeconomic level were recruited at an outpatient clinic (A Coruña, Spain) from January to December 2015. Of this eligibility sample, 100 participants signed the informed consent form and were enrolled into the study. Thus, 50 older adults with LTD and 50 older adults without any foot conditions were selected by means of a nonprobability consecutive sampling method. The age of the older adults ranged from 65 to 88 years. The exclusion

criteria were <65 years of age, immunocompromised participants, history of foot trauma, previous foot surgery, neurological conditions, non- or semi-autonomous in daily life activities, refusal to sign the informed consent form, inability to understand the instructions of this study, and patients from other nationalities (non-Spanish subjects, in order to self-report the Spanish version of the Foot Health Status Questionnaire).<sup>22</sup>

### Sample size

Considering a minimal important difference score of at least 21<sup>22,23</sup> between both the groups in the Foot Health Status Questionnaire (FHSQ), a standard deviation of 29,<sup>24</sup> two-tailed hypothesis, an alpha risk of 5%, and a statistical power of 80%, a total of at least 94 participants must be included ( $n=47$  in each group). Controls were matched according to age, gender, and presence of LTD.

### Procedure

All the measurements were performed by the same evaluator. First, height, weight, and body mass index (BMI) were registered. Second, the presence of LTD was established using the Kelikian push-up test. This widely accepted maneuver evaluating the integrity of the lesser toes evaluates the relative reducibility of the deformity by pushing or loading the plantar metatarsal head to determine whether the toe will reduce or straighten out.<sup>25</sup> Indeed, the examiner pressed upward on the plantar aspect of the metatarsal head. Regarding flexible deformities, the metatarsophalangeal joint was aligned and a more normal position of the proximal phalanx was assumed during the test.<sup>26</sup> Presence of LTD was determined in both feet, uni- or bilaterally.

Participants self-reported the FHSQ which evaluated the foot health-related quality of life.<sup>27</sup> The FHSQ may be recognized as a Spanish validated test.<sup>28</sup> Foot-specific and general health-related quality of life was evaluated using the items of the FHSQ (version 1.03), which comprised three sections with four main domains or subscales for each section. Section 1 comprised of 13 questions about four foot health-related subsections: foot pain, foot function, footwear, and general foot health. High level of content, criterion, and construct validity (Cronbach  $\alpha=0.89-0.95$ ) as well as high retest reliability (intraclass correlation coefficient  $=0.74-0.92$ ) were shown in section 1.<sup>29</sup> Furthermore, this section was the most appropriate measurement of health-related quality of life in a population with foot pain.<sup>17</sup>

Each domain comprised of a specific number of questions about pain (four items), function (four items), footwear

(three items), and general foot health (two items). Pain and function assessments were based on physical characteristics, footwear evaluation related to shoes availability and comfort, and general foot health perception was based on the patients' self-assessment of their foot state. Each question provided various answers, and a Likert-type ordinal scale (words or phrases corresponding to a numeric scale) was applied. The descriptors for these scales varied for each subscale, and the questionnaire was completed by indicating only one response, whichever was thought to be the most appropriate. A global score was not provided. Nevertheless, an index for the responses of each domain was obtained by a computer program (The FHSQ, Version 1.03). After processing the data, we obtained a score ranging from 0 to 100, where 0 represented the worst state of foot health and 100 represented the best possible state. Furthermore, the software also provided graphical images from the outcomes.

Section 2 evaluated questions about four general health-related subscales: general health, physical activity, social capacity, and vigor. The subscales and questions in section 2 were adapted from the validated Medical Outcomes Study 36-Item Short-Form Health Survey.<sup>30,31</sup> Finally, section 3 collected data about socioeconomic status, comorbidity, service utilization and satisfaction, and medical history.

## Ethical considerations

The Research and Ethics Committee of the Universidade da Coruña (Spain), code number CE 10/2015, approved this study. All voluntary participants signed a written consent form before the study began. Research ethical standards on human being experimentation were considered according to the World Medical Association of Helsinki Declaration, the Europe Council Convention on Human Rights & Biomedicine, the UNESCO Universal Declaration on the Human Genome and Human Rights as well as other relevant national requirements.

## Statistical analysis

Initially, a descriptive data analysis was performed. Qualitative variables were described as absolute values and percentages. Quantitative variables were described as mean, standard deviation (SD), and maximum and minimum values. All variables were evaluated for normality of distribution by means of Kolmogorov-Smirnov test. Normal distribution was considered if  $p > 0.05$ . Parametric independent Student's *t*-tests were performed for variables that were

adjusted to the normal curve and non-parametric Wilcoxon test was applied for variables that were not adjusted to the normal curve. The IBM SPSS Statistics 19 package was used for data analysis. The FHSQ Version 1.03 was applied in order to evaluate the quality of life scores related to foot health.

## Results

A total of 100 older adults aged between 65 and 88 years completed the study. The sample comprised 50 (50%) participants with LTD and 50 (50%) participants without any foot conditions. Foot pain, foot function, general foot health, general health, physical activity, social capacity, footwear, and vigor variables ( $p < 0.05$ ) did not show a normal distribution, and age, weight, height, and BMI showed a normal distribution ( $p > 0.05$ ). Table 1 shows the sociodemographic and clinical characteristics of the participants. There were no differences for age, height, weight, and BMI between case and control groups ( $p > 0.05$ ). The control group was free of toe deformities.

Comparing the FHSQ scores, we summarized the results for total, case, and control participants in Table 2. Statistically significant differences ( $p < 0.05$ ) for FHSQ scores were shown between case and control groups, with normalized reference values, both in questionnaire section 1, which assessed the older adults' quality of life related specifically to foot health, and in section 2, which assessed the older adults' health in general.

## Discussion

To our knowledge, the current study may be considered as the first study to estimate the quality of life related to foot health

**Table 1** Sociodemographic characteristics of the sample population

	Total, N=100	LTD, N=50	No LTD, N=50	p-value*
Age, years	74.39±6.02 (65–88)	75.50±5.89 (66–88)	73.28±6.01 (65–88)	0.065
Weight (kg)	77.54±7.35 (50–93)	77.84±8.29 (50–93)	77.24±6.34 (62–88)	0.685
Height (cm)	166.94±6.7 (155–184)	167.32±6.6 (156–184)	166.50±6.8 (155–182)	0.542
BMI (kg/m <sup>2</sup> )	27.91±3.11 (19.05–34.77)	27.85±3.03 (19.05–34.77)	28.00±3.23 (20.99–34.02)	0.804

**Notes:** Data presented as mean ± SD (range). In all the analyses,  $p < 0.05$  (with a 95% confidence interval) was considered statistically significant. \*p-values are from independent Student's *t*-test.

**Abbreviations:** BMI, body mass index; FHSQ, Foot Health Status Questionnaire; LTD, lesser toe deformities; SD, standard deviation.

**Table 2** FHSQ mean scores for the case and control groups

	Total, N=100	LTD, N=50	No LTD, N=50	p-value**
Foot pain	66.40±22.39 (11–100)	56.51±22.48 (11–94)	76.29±17.54 (19–100)	0.001
Foot function	77.88±22.41 (6–100)	71.37±21.25 (19–100)	84.38±21.84 (6–100)	0.003
Footwear	25.83±25.96 (0–92)	17.50±21.77 (0–75)	34.17±27.32 (0–92)	0.001
General foot health	32.40±24.02 (0–100)	22.60±20.23 (0–100)	42.20±23.66 (0–85)	0.001
General health	47.00±19.04 (0–80)	45.00±17.99 (0–80)	49.00±20.02 (0–80)	0.295
Physical activity	67.00±27.66 (0–100)	60.89±29.78 (0–100)	73.11±24.13 (6–100)	0.026
Social capacity	76.50±23.18 (13–100)	77.00±21.78 (38–100)	76.00±24.72 (13–100)	0.830
Vigor	45.81±22.82 (0–94)	39.25±22.70 (0–94)	52.38±21.2 (0–94)	0.003

**Notes:** Data presented as mean ± SD (range). In all the analyses,  $p < 0.05$  (with a 95% confidence interval) was considered statistically significant. \*\*p-values are from Wilcoxon test.

**Abbreviations:** FHSQ, Foot Health Status Questionnaire; LTD, lesser toe deformities; SD, standard deviation.

and health in general of older adults with LTD. This novel study supports evidence showing how the presence of LTD produced lower scores in quality of life related to health in general and to foot health specifically. Previous research studies with older adults of both genders were consistent with our results, because LTD may influence the plantar pressure,<sup>31</sup> postural disturbances,<sup>32</sup> be significantly associated with older adults' falls, and lead to serious foot problems in older adults.<sup>33</sup>

Indeed, the older adults with LTD were diagnosed according to the Kelikian push-up test measurements, according to prior studies which evaluated LTD for diagnosis and treatment of foot alterations.<sup>34</sup>

Foot health is essential for older people to maintain functional capacity for as long as possible, because >75% of older adults with foot problems are at increased risk of falls<sup>3</sup> and impaired balance and they considered foot problems as a risk factor for limited mobility.<sup>35</sup> López López et al<sup>36</sup> analyzed a sample of older patients with different degrees of hallux valgus deformity and concluded a lesser satisfaction with the quality of life related to foot health, which may be associated with greater degree of hallux valgus, regardless of gender. Therefore, importance of medical care and treatment of the foot should be recommended in order to prevent illnesses and deformities of the foot, especially in older adults.<sup>36</sup> Although prior studies have prioritized section 1 of the FHSQ evaluating four domains,<sup>37,38</sup> the present study has prioritized

both sections 1 and 2 assessing eight domains according to previous research studies.<sup>24,36</sup>

Nevertheless, some limitations should be acknowledged. First including individuals from various countries would be beneficial to improve the strength of the study and identify more subcategories of LTD. In addition, despite a sample size calculation being carried out, the consecutive sampling bias should be considered and a simple randomization sampling process could be more adequate for future studies. Second, expanding data collection to other countries could be useful to identify different perceptions of quality of life from various cultures and to identify the involved mechanisms. Third, the degree of LTD was not registered and the presence of LTD was only determined according to the Kelikian push-up test measurements. According to prior studies regarding the diagnosis and treatment of foot conditions in older adults, future studies should consider the degree of LTD in order to state its relationship with FHSQ scores.<sup>30</sup> Finally, although the Kelikian push-up test has been widely applied in prior studies,<sup>25,26</sup> the psychometric properties of this test have not been measured and this major limitation should be considered in future studies.

This highlights that further research may be necessary in order to determine different therapeutic interventions used by medical professionals to improve foot health and quality of life, especially in older people.

## Conclusion

In conclusion, this study confirms that older adults with LTD have lower scores in quality of life related to foot health, regardless of gender. Therefore, proper care and control of foot health may be extremely important in order to prevent the appearance or development of LTD.

## Availability of data and material

Please contact author for data requests.

## Author contributions

All authors (DLL, MMV, MELI, CCL, DRS, PPL, RBBV) contributed equally to this work in the concept, design, analyses, interpretation of data, drafting of manuscript or revising it critically for important intellectual content.

## Disclosure

The authors did not receive any financial assistance from, or have any personal relationships with, other people or organizations that could inappropriately influence (bias) their work. The authors report no conflicts of interest in this work.



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